

reader). Such an arrangement can advantageously be used to measure clotting times of a blood or plasma sample. For measuring clotting times, the conduit or an upstream component preferably comprises a dry reagent necessary for the specific clotting measurement (e.g., activated clotting time, whole blood clotting time, prothrombin time, thrombin time partial thromboplastin time and the like).

[0226] Vent ports as described above are, preferably, apertures on the surface of the cartridge that are in fluidic communication with fluidic chambers or conduits within the cartridge. In a laminated cartridge construction, the vent ports may be provided, for example, by apertures in cover layers that seal against a cartridge body to define planar fluidic networks or alternatively, by through-holes exposed on one surface of the cartridge body that communicate with fluidic networks on the opposing side. The vent ports act as control ports that allow a cartridge reader to control the movement of fluid in the cartridge, e.g., by a combination of sealing one or more ports, opening one or more ports to atmospheric pressure, connecting one or more ports to a source of positive pressure and/or connecting one or more ports to a source of negative pressure. The vent ports may also be used to introduce air into liquid streams passing through the fluidic conduits of the invention, for example, to segment the fluid streams with slugs of air. The introduction of air may be used to prevent mixing of two liquid slugs passed sequentially through a conduit, to clear a liquid from a conduit and/or to enhance the efficiency of a wash step. Preferably, the vent ports are arranged in a single row at a common location along the cartridge body's width. Such an arrangement and configuration of the control points advantageously allows the interface between the cartridge reader and the cartridge to be simplified. For example, using such a preferred configuration allows the cartridge reader to make use of a single fluidic mating device for placing the cartridge into fluidic communication with the cartridge reader. Such a configuration also allows the motion control subsystem(s) to be simplified in that a single motor or actuation device may be used to actuate the fluidic mating device and move it into sealing engagement with the cartridge body.

[0227] FIG. 9 is a schematic representation of cartridge 900, one preferred embodiment of a cartridge of the invention that incorporates many of the fluidic features described above. This exemplary embodiment depicts a cartridge comprising an electrode array of the invention as described above. The skilled artisan, however, can readily adapt the fluidic components and design to cartridges employing other detection chamber designs and/or detection technologies. The cartridge schematic shown in FIG. 9 comprises various compartments including a sample chamber 920, assay reagent chamber 925, waste chambers 930 and 931 and detection chambers 945 and 946 comprising electrode arrays 949a and 949b and electrode contacts 997 and 998. Also depicted in FIG. 9 are fluid ports/vents 950-953 and 980 that may be utilized as fluidic control points, vents for allowing a chamber to equilibrate with atmospheric pressure, ports for introducing air bubbles or slugs into a fluid stream and/or as fluidic connections to a cartridge reader. FIG. 9 also depicts a number of fluidic conduits (shown as lines connecting the various chambers) that establish a fluidic network that connects the various compartments and/or fluid ports/vents. The fluidic conduits may comprise distribution points (e.g., branch points such as distribution point 976 that are adapted to distribute a fluid to two or more locations/compartments

in a cartridge). Other fluidic features that are shown in FIG. 9 include pill chambers/zones 990,991 for each of the read chambers. FIG. 10 depicts a three dimensional representation of the fluidic network formed by the various fluidic components employed in a preferred embodiment of FIG. 9.

[0228] Sample chamber 920 is a chamber defined within cartridge 900 that is adapted for receiving a sample, preferably a liquid sample, to be analyzed in the cartridge. Sample chamber 920 includes a sample introduction port 921, and is linked to vent port 953 through a vent conduit and detection chambers 945 and 946 through sample conduit 901 having sample conduit branches 940 and 941. Preferably, cartridge 900 also includes a sealable closure for sealing sample introduction port 921. Reagent chamber 925 is a chamber adapted to hold a liquid reagent and includes a vent conduit linked to vent port 950 and reagent conduit 902 linked to the sample conduit (preferably, between sample chamber 920 and distribution point 976). Also linked to the sample conduit is air chamber/trap 975 linked to vent port 980. This arrangement allows for adding/removing air into/from the fluid stream(s) (e.g., to reagent or sample streams directed from reagent chamber 925 or sample chamber 920 towards detection chambers 945 or 946) in the fluidic pathway by applying positive pressure or suction to vent port 980. Pill chambers/zones 990 and 991 hold dry reagents and are positioned, respectively, in the fluidic pathway between sample port 920 and detection chambers 945 and 946 so that liquid passing through the chamber/zones will reconstitute the dried reagents and carry the resulting solutions into the detection chambers. Reagent chamber 925, air chamber trap 975, vent port 980 and/or pill chamber zones 990 and/or 991 may optionally be omitted.

[0229] Detection chambers 945 and 946 are adapted for carrying out a physical measurement on a sample, preferably an electrochemiluminescence measurement, most preferably a measurement employing an electrode array that is configured to be fired in a pair-wise fashion (as described above). Optionally, detection chamber 946 is omitted. As depicted in the preferred embodiment of FIG. 9, detection chambers 945 and 946 have different geometrical cross-sections than their respective input and output channels to which they are in fluidic communication. As such, it is preferable to incorporate transitional fluidic segments (947a,b and 948a,b) at the inputs and outputs of the read chambers such that fluid flow may be appropriately transitioned between the dissimilar regions. Preferably, the transition is designed to minimize the transition length; e.g., incorporating a diffusers/nozzles with as wide an angle as possible, while being gradual enough to prevent trapping of air bubbles. Detection chambers 945 and 946 are connected via waste conduits 960,961 to waste chambers 931 and 930. Waste chambers 930 and 931 are chambers configured to hold excess or waste fluids and are also connected, respectively, to vent port 952 via a vent conduit and vent port 951 via a vent conduit. The use of multiple waste chambers advantageously allows fluid flow through the multiple chambers to be controlled independently via the application of vacuum or pressure to the waste chamber vent ports. Alternatively, only one waste chamber is used (e.g., waste chamber 930 is omitted and detection chambers 945 and 946 are both connected to waste chamber 931).

[0230] In cartridges for conducting binding assays for analytes of interest, pill zones 990 and 991 preferably